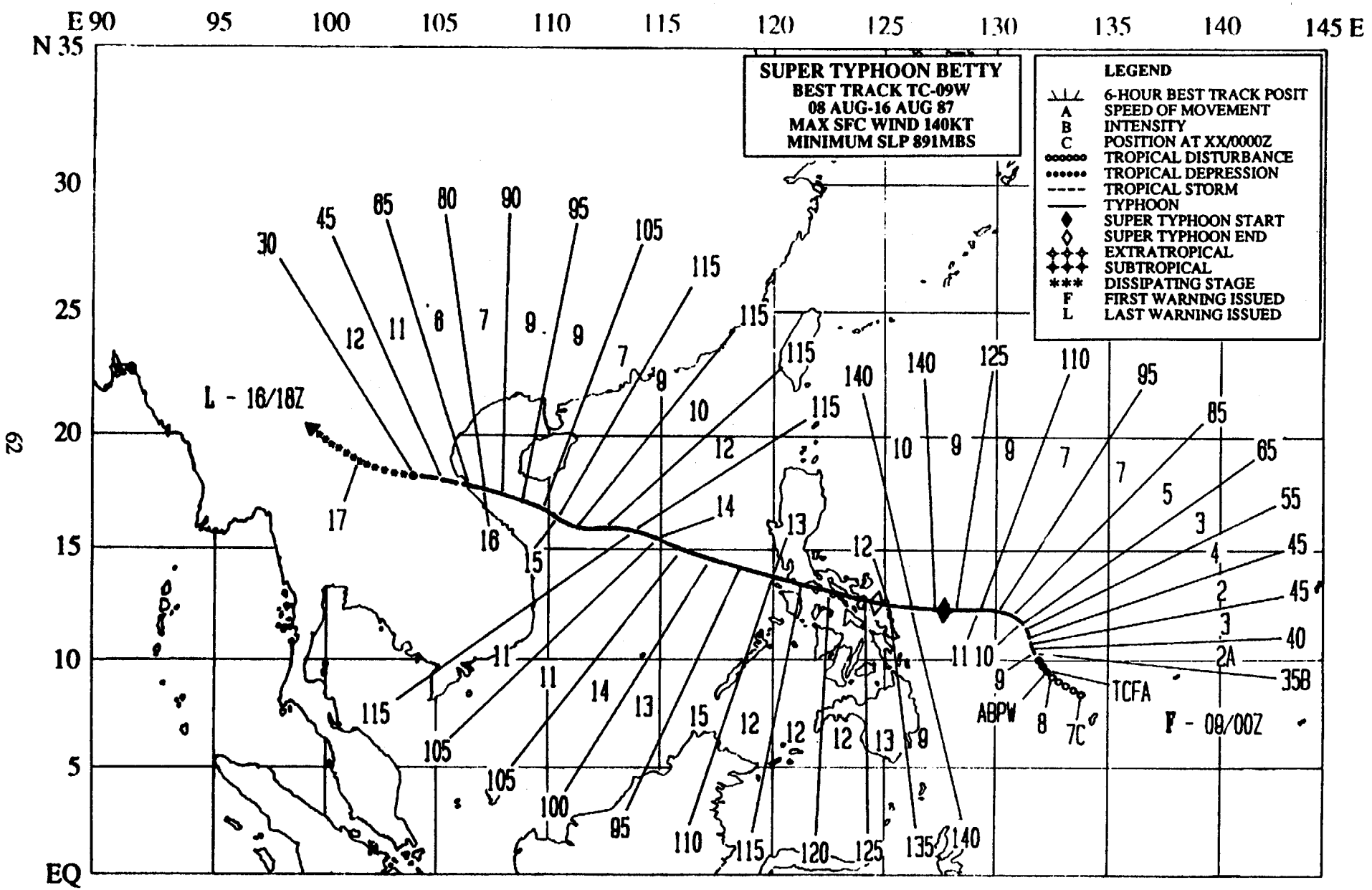
SUPER TYPHOON BETTY
BEST TRACK TC-09W
08 AUG-16 AUG 87
MAX SFC WIND 140KT
MINIMUM SLP 891MBS
LEGEND
6-HOUR BEST TRACK POSIT
SPEED OF MOVEMENT
INTENSITY
POSITION AT XX/0000Z
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
SUPER TYPHOON START
SUPER TYPHOON END
EXTRATROPICAL
SUBTROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
E 90
95
100
105
110
115
120
125
130
135
140
145 E
N 35
30
25
20
15
10
5
EQ
62
L - 16/18Z
TCFA
F - 08/00Z
ABPW

SUPER TYPHOON BETTY (09W)

Super Typhoon Betty was the first of two tropical cyclones to hit Vietnam during the month of August. Betty was also the second super typhoon (intensity equal to or greater than 130 kt (67 m/sec)) of the 1987 western North Pacific tropical cyclone season and had the lowest reported minimum sea-level pressure (891 mb). It intensified (deepened) explosively (Holliday and Thompson, 1979) prior to making landfall in the Philippine Islands. Other distinguishing characteristics were the large size of the area of intense convection, the small radius of maximum wind and the associated strong low-level southwest monsoonal inflow. Also of note was the large radius of gale force winds in Betty's northwest semicircle, due to the enhancement of surface winds by a strong pressure gradient between the tropical cyclone and the subtropical ridge.

After Typhoon Alex (08W), which had developed in the low-level southwest monsoon trough, dissipated on the 28th of July, the mid-level subtropical ridge again became well-established over the western North Pacific. Coincident with Alex's (08W) movement toward the north was the replacement of the strong low-level southwest monsoonal flow over the South China Sea by the ridge.

Betty was first detected on the 7th of August as a tropical disturbance embedded in the monsoon trough, which extended from the Marshall Islands westward to the Philippine Islands. Satellite intensity estimates (Dvorak, 1984) showed surface winds of 25 kt (13 m/sec) when the disturbance was 65 nm (120 km) north-northwest of the island of Belau in the western Caroline Islands. The system cloudiness developed rapidly early on the 8th prompting JTWC to issue a Tropical Cyclone Formation Alert at 0300Z. Figure 3-09-1 shows the disturbance on the 8th of August exhibiting

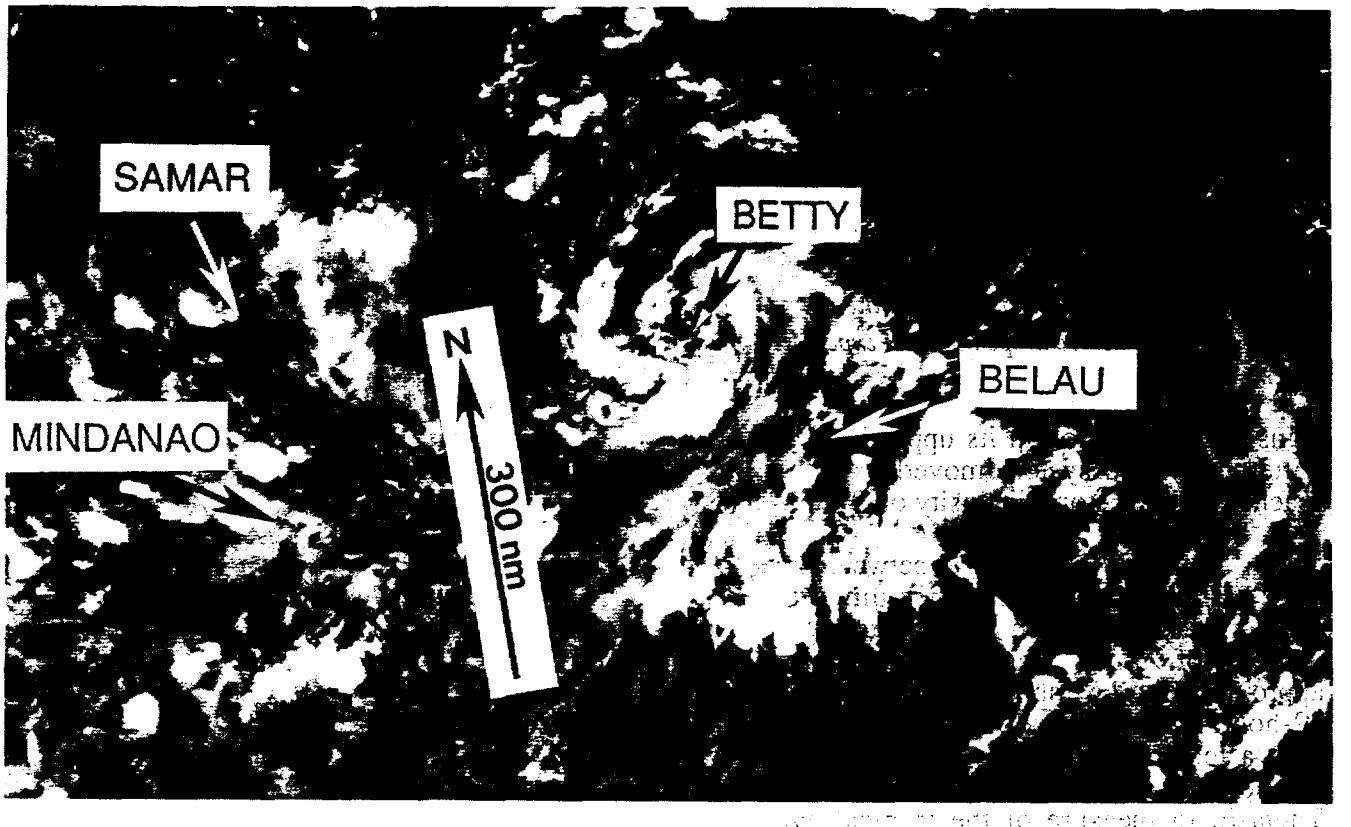

Figure 3-09-1. Super Typhoon Betty as a tropical disturbance in the monsoon trough. Signs of organized upper-level outflow were present (081257Z August DMSP visual imagery).

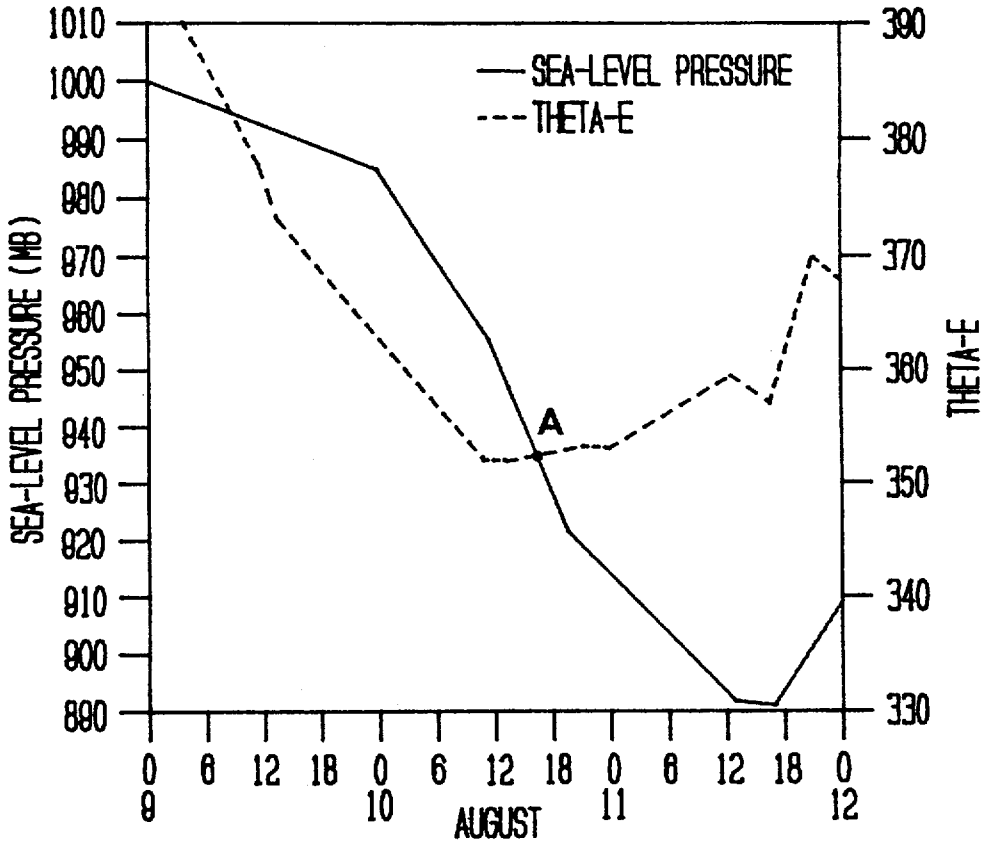

Figure 3-09-2. Plot of Betty's minimum sea-level pressure and central 700 mb equivalent potential temperature during the period 082300Z and 120000Z August. Once the critical crossing of the surface pressure and Theta-E traces occurred (at point A), explosive deepening was expected.

signs of organization in its upper-level outflow pattern. The system moved westward and reached tropical storm intensity on 9 August.

In the 37-hour period between 100000Z and 111300Z, Betty's minimum sea-level pressure dropped from 985 mb to 892 mb, a decrease of 93 mb. This translates to a drop of approximately 2.5 mb/hr (sustained for at least 12-hours) or explosive intensification. JTWC uses a technique (Dunnavan, 1981), in which the 700 mb equivalent potential temperature, Theta-E, (a measure of the tropical cyclone's thermodynamic energy based on the central 700 mb temperature and dew point) and the minimum sea-level pressure are compared to forecast explosive intensification. This technique forecasts intensification to below 925 mb whenever the plots of minimum sea-level pressure and Theta-E intersect near the critical values of 950 mb and 360 degrees Kelvin, both values being statistical means derived from analysis of past intense tropical cyclones. Figure 3-09-2 is a plot of Betty's minimum sea-level pressure and Theta-E during the period 082300Z to 120000Z. At point A (101730Z) the two lines intersect, as the minimum sea-level pressure at this time is plummeting downward. Based on this information, explosive deepening was forecast.

Figure 3-09-3 shows Super Typhoon Betty near maximum intensity with a well-defined eye and intense convection covering a large area around the system. Aircraft reconnaissance on the 10th and 11th of August consistently located the maximum surface winds 10 to 15 nm (19 to 28 km) from the center and radar eye diameters of 11 to 15 nm (20 to 28 km). Both measurements showed the center to be very small and compact.

The threat posed by Super Typhoon Betty resulted in the evacuation of aircraft from Cubi Point Naval Air Station and Clark Air Base, as well as the movement of several ships from Subic Bay. Later, news services reported at least twenty people were killed, seven missing and more than 60,000 left homeless as a result of Betty's passage over the Philippine Islands. Damage to buildings and crops was estimated in the millions of dollars.

Betty weakened from 140 kt (72 m/sec) to 110 kt (57 m/sec) as it accelerated across the central Philippine Islands. The subtropical ridge continued to be the dominant synoptic-scale feature, extending westward into the South China Sea.

After entering the South China Sea early on the 13th of August and still maintaining 95 kt (49 m/sec) winds, Super Typhoon Betty began to reintensify over water as it continued on a west-northwesterly track. By 140600Z, Betty's intensity had peaked again, at 115 kt (59 m/sec), 390 nm (722 km) south of Hong Kong. Betty slowly weakened as it began to interact with the mountains of Vietnam and the island of Hainan which prevented further intensification by hampering its low-level inflow. Crossing the Gulf of Tonkin in less than a day, Betty slammed into the coast of Vietnam 190 nm (352 km) south of Hanoi. The final warning on Betty was issued at 161800Z as the system weakened and dissipated over the mountains inland.

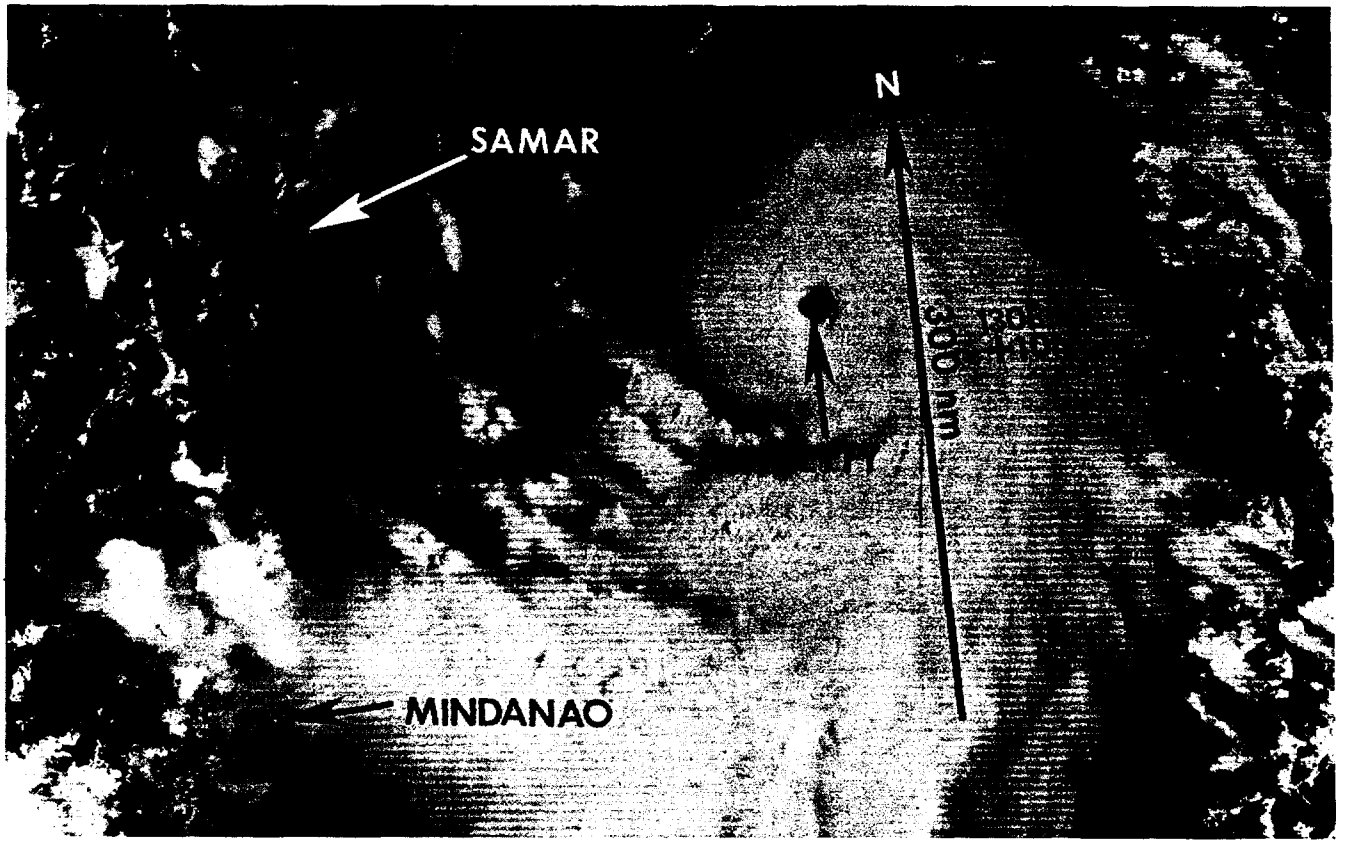

Figure 3-09-3. Super Typhoon Betty near maximum intensity. This expanded image shows the well-defined eye and large symmetrical area of intense convection (110057Z August DMSP visual imagery).